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# Air Resources Board

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Mr. Larry Will, Chairman
General Engineering Committee
Portable Power Equipment Manufacturers Association (PPEMA)
4340 East West Highway, Suite 912
Bethesda, MD 20814

Dear Mr. Will:

This is in response to your letters dated November 22 and December 10, 1999, and January 18, March 8 and April 7, 2000, concerning test procedures for the certification of small off-road engines (SOREs) below 65 cubic centimeters (cc) in displacement. The issues were also discussed in a meeting between PPEMA and the Air Resources Board (ARB) in February 2000. Below are the three issues of concern to PPEMA followed by ARB response.

ISSUE #1: PPEMA requests approval to use duty cycles of three, six and twenty minutes for durability testing. Manufacturers should be able to use their engineering judgment to determine which cycle is applicable to a particular engine family (EF).

ARB RESPONSE: For durability testing of SOREs below 65 cc, the ARB has allowed a three-minute duty cycle for chain saw engines, and a twenty-minute duty cycle for all other engines. Based on the survey submitted by a PPEMA manufacturer, the ARB has also conditionally allowed that manufacturer to use a six-minute duty cycle. The ARB has suggested that PPEMA sponsor an extensive, association-wide survey of in-use duty cycles. The goal would be to establish generalized duty cycles acceptable to ARB in order to avoid proliferation of duty cycles among manufacturers or even within a manufacturer. No PPEMA-sponsored survey has been submitted to date.

In the interest of resolving this issue and moving forward, and partly based on the survey by the PPEMA manufacturer mentioned above, the ARB will allow the use of these duty cycles with the following stipulations (discussed on May 19, 2000, at a meeting with PPEMA representatives).

1) The use of the three-, six- and twenty-minute duty cycles for specific engine applications are approved as requested by PPEMA. For engines used in applications not mentioned by PPEMA, e.g., wheeled trimmers, portable pumps and generators, and blowers that are neither hand-held or back-packed, the twenty-minute duty cycle must be used. For all other engine applications,

PPEMA manufacturers should contact their assigned ARB Certification Section engineer for permission to use a particular duty cycle prior to running their durability programs.

2) For an EF that has mixed equipment uses, the duty cycle should be the longest applicable.

3) These duty cycles are the minimum acceptable. PPEMA manufacturers are permitted to use a longer cycle without prior ARB approval. On the other hand, the ARB will not approve the use of a shorter cycle unless the manufacturer provides specific data demonstrating the applicability of a shorter cycle for the engine involved.

ISSUE #2: PPEMA requests clarification on the need to perform manufacturer-conducted confirmatory testing when a test engine's emission results provide less than a fifteen percent compliance margin from the family emission limit (FEL) chosen by the manufacturer. Typically, a manufacturer sets an FEL close to the certification value in order to obtain the maximum number of credits under the average, banking and trading (ABT) program; any marginal compliance therefrom would be offset by these credits.

ARB RESPONSE: Factors such as an engine and its emission control system's design features and capabilities, test-to-test variability, and production variations should be considered when a manufacturer sets the FEL. The certification test should only serve to validate these factors, not as the tool for setting the FEL. A manufacturer failing a production quality audit (QA) test is not automatically allowed to raise the FEL to erase the failure. For these reasons, it has been ARB policy to require manufacturers to conduct a retest for confirmation purposes when the initial test yields a certification value (after applying the deterioration factor (DF)) that equals or exceeds eighty-five percent of the FEL (or standard, as applicable). A certification value that is within fifteen percent of the FEL (standard) is considered marginal compliance.

However, in response to PPEMA's concerns, and based on the experience with SORE testing gained since 1995, the staff has developed an optional retest criteria that it believes will minimize manufacturers testing burden while ensuring the integrity of certification data. Under this option, a manufacturer must determine the standard deviation "A" of all of its paired certification tests (initial tests and retests) and the standard deviation "B" of all of its production QA tests. For a marginally complying EF, the manufacturer may add the larger of the standard deviation "A" and "B" to the initial test and then apply the DF. If the result is below the FEL (standard), then the initial test will be accepted for certification without a need for a retest. However, if the result (test data + standard deviation "A" or "B", with the DF applied) equals or exceeds the FEL (standard), a retest is then required and will be used for certification. A manufacturer should submit to ARB all test data and its determination of the standard deviations "A" and "B" in advance of the start of its certification program for a model-year (MY) to allow sufficient time for staff review and concurrence of these "A" and "B" values.

ISSUE #3: PPEMA requests approval to use common DFs for engine families (EFs) that have similar technologies and durability periods. Testing has shown that a manufacturer's DFs for a given engine technology remains constant among different EFs. Based on PPEMA data, conventional two-stroke engines without exhaust after-treatment have shown improved emissions over the intended useful life and should, therefore, be assigned a DF of 1.0. Use of common DFs would reduce unwarranted testing.

ARB RESPONSE: ARB staff reviewed PPEMA's study of tests conducted by its members during 1992-1994, but did not reach the same conclusions. Among staff's concerns are the study's methodology, test procedures and data interpretation. Certification data generated in accordance with durability and emission test procedures acceptable to ARB to date do not agree with PPEMA's conclusion of DFs of 1.0 for conventional two-stroke engines. Also, it is common experience that older two-stroke engines generally emit more smoke and exhaust odor, produce less power and/or consume more fuel. All these indications appear to point to higher emissions per unit of power. As durability testing is required for the first time starting with MY 2000 for SOREs below 65 cc, staff indicated to PPEMA that sufficient test data, measured in accordance with approved durability and emission test procedures, need to be accumulated to facilitate a detailed analysis about their emission deterioration trends.

As permitted in regulations, EFs that are similar in engine and emission control designs and emission characteristics may be grouped for durability demonstration purposes. From each durability group, the engine that is expected to exhibit the highest deterioration rate should be tested, and its durability data may be carried across with ARB approval to the other EFs in the same durability group. The ARB believes this is a balanced approach between a need to have valid durability data and a desire to minimize manufacturer test burden.

Should you have further questions on these issues, please contact Mr. Duc Nguyen, Manager, Certification Section, or Mr. Dean Hermano, Staff Engineer, at (626) 450-6103, or by e-mail at dhermano@arb.ca.gov.

Sincerely,

R. B. Summerfield, Chief
Mobile Source Operations Division